

4241-685

**Section II (Remarks)**

Claims 1, 3, 8, 16, 25-30, 32-41, and 44 have been amended herewith, and claim 9 has been cancelled. No new matter has been added within the meaning of 35 U.S.C. § 132.

**A. Affirmation of Provisional Election of Group I (claims 1-51) With Traverse**

In the September 27, 2005 office action, the examiner imposed a restriction requirement against claims 1-120 of the present application and required election of one of the following two groups of claims:

Group I: claims 1-51, directed to a GaN material, wafer and electronic device  
classified in class 428, subclass 698

Group II: claims 52-120, directed to a wafer growth process, classified in class  
117, subclass 84.

Applicants hereby affirm the provisional election with traverse of claims 1-51 (Group I) made telephonically by Mr. Steven J. Hultquist.

The withdrawal of claims 52-120 herein is with express reservation of the right to file a divisional patent application directed to the subject matter of such withdrawn claims, during the pendency of the present application or during the pendency of a further continuation or divisional patent application based on and claiming priority of the present application.

**B. Claim Rejection Under 35 U.S.C. § 112**

In the September 27, 2005 Office Action, claim 3 was rejected under 35 U.S.C. § 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which Applicants regard as the invention. Specifically, claim 3 was rejected as lacking antecedent basis for reciting the limitation "GaN material according to claim 1," since claim 1 failed to recite any GaN material.

Claim 3 has been amended herewith to traverse this rejection. Accordingly, withdrawal of the rejection under 35 U.S.C. § 112, second paragraph, is respectfully requested.

C. Claim Rejections Under 35 U.S.C. § 102

1. Rejections Under § 102 Generally

"Anticipation requires the disclosure in a single prior art reference of each element of the claim under consideration." *W.L. Gore & Assocs. v. Garlock*, 721, F.2d 1540, 220 USPQ 303 at 313 (Fed. Cir. 1983), *cert. denied*, 469 U.S. 851 (1984). It is not enough that the prior art reference disclose all the claimed elements in isolation. Rather, "anticipation requires the presence in a single prior art reference disclosure of each and every element of the claimed invention, arranged as in the claim." *Lindemann Maschinenfabrik GmbH v. American Hoist & Derrick Co.*, 730 F.2d 1452, 221 USPQ 481, 485 (Fed. Cir. 1984) (emphasis added). Further, "[u]nder 35 U.S.C. § 102, anticipation requires that ... the prior art reference must be enabling, thus placing the allegedly disclosed matter in the possession of the public." *Akzo, N.V. v. United States Int'l Trade Comm'n*, 808 F.2d 1471, 1 USPQ2d 1241, 1245 (Fed. Cir. 1986).

2. Traversal of Rejections Under 35 U.S.C. 102 Based On U.S. 6,468,882 (Motoki)

In the November 9, 2005 Office Action, claims 1-3, 8, 10-13, 17-22, 26-37 and 41-51 were rejected under 35 U.S.C. 102(b) as being anticipated by U.S. 6,468,882 to Motoki et al. ("Motoki"). Such rejections are traversed by the present claims.

a. Disclosure of Motoki

4241-685

Motoki discloses GaN single crystal substrates produced by growing a first ingot of single crystal GaN in such a manner to provide threading dislocations in substantially a single direction, slicing (cutting) the GaN ingot in the planes parallel to the crystal growth direction (i.e., perpendicular to the crystal growth surface) to form seeds having dislocations running parallel to the faces thereof, and then performing subsequent GaN crystal growth in a direction perpendicular to the first growth to yield low defect density GaN. See, e.g., Motoki, col. 14, line 57 – col. 15, line 18. Defect densities in the range of amended claim 1 presented herewith (e.g.,  $\sim 10^6$  dislocations per  $\text{cm}^2$ ) are only achieved by Motoki through the use of multiple orthogonal growths – i.e., including a **first growth step**, a **first cutting step**, and at least a **second growth step** proceeding in a direction 90 degrees removed from the first..

“The multiple growths mean repetitions of slicing a GaN ingot along dislocations into seeds and growing a GaN ingot on the GaN seed.”

\* \* \*

“Namely, a **change of the growth direction at 90 degrees in double growths** enables the present invention to reduce dislocations.”

\* \* \*

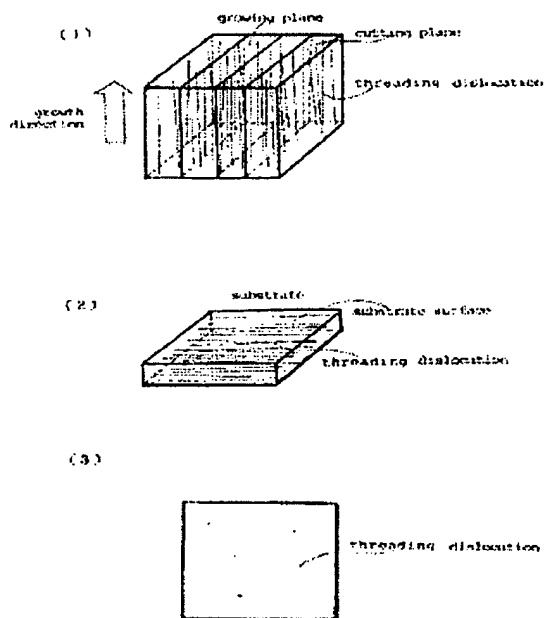
“True reduction of dislocations is accomplished by **multiple growths which vary the growing directions g.**”

Motoki, col. 14, line 63 – col. 15, line 14 (emphasis added).

FIG. 10 of Motoki is reproduced below to help visualize a first growth-and-slice cycle.

4241-685

Fig. 10



See also Motoki, col. 19, lines 9-15:

This invention is **applicable to multiple growths** which have far more effect for reducing dislocations. A second growth makes a thick GaN crystal on a C-, M- or A-surface GaN seed which is obtained by slicing a GaN ingot in planes parallel to the growth direction. Then, the GaN is sliced along the dislocations. **Repetitions of the growth and the parallel-dislocation slice decrease substantially the dislocations by prohibiting the dislocations from succeeding.**

Motoki fails to teach any procedure not involving multiple orthogonal growths (i.e., at least one grow-slice-grow sequence) for producing low dislocation GaN

**b. Novelty of Independent Claim 1 and Claims Depending Therefrom**

Independent claim 1 requires:

- 1. Uncut single crystal III-V nitride material having a large area of at least 15 cm<sup>2</sup> on a face thereof and having a uniformly low dislocation**

4241-685

**density not exceeding  $3 \times 10^6$  dislocations per  $\text{cm}^2$  of growth surface area on the face.**

(Emphasis added.)

The “uncut” limitation coupled with the uniformly low dislocation density not exceeding low  $3 \times 10^6$  dislocations per  $\text{cm}^2$ , provides a primary basis for distinguishing the claim over Motoki. As noted previously, Motoki is directed to at least one “grow-slice-grow” cycle in which the **intermediate cutting step is required** to achieve low defect density within the scope of claim 1. See, e.g., Motoki, col. 14, line 63 – col. 15, line 14. As a result, Motoki fails to teach the fabrication of “**uncut** single crystal III-V nitride material... having a uniformly low dislocation density not exceeding  $3 \times 10^6$  dislocations per  $\text{cm}^2$  of growth surface area on the face” as required by the claim.

Another basis for distinguishing claim 1 over Motoki is the “large area of at least  $15 \text{ cm}^2$  on a face thereof.” Motoki teaches fabrication of ingots in a size range of 2.5 cm to 3 cm on each edge – i.e., between  $6.25 \text{ cm}^2$  and  $9 \text{ cm}^2$ . This size range is well below the  $15 \text{ cm}^2$  required by claim 1.

In contrast to Motoki, the present invention does not require GaN growth to such extreme thicknesses to obtain uniformly low defect densities. Various methods described in the application permit fabrication of large area, but low thickness, III-V (e.g., GaN) articles having uniformly low defect densities without requiring the impracticable first growth-slicing-second orthogonal growth steps of Motoki. This permits very large area (e.g.,  $15 \text{ cm}^2$ ) and uniformly low defect density III-V nitride materials to be grown without requiring ridiculously thick growths, intermediate cutting steps, and unduly long growing times

4241-685

Since claims 2, 3, 8, 10-13, and 17-22, 50, and 51 all depend, whether directly or indirectly, from claim 1, these claims inherently include all of the limitations of claim 1. As a result, each of these dependent claims is similarly novel over Motoki for at least the reasons stated above.

For at least these reasons, Motoki fails to disclose “each and every element of the claimed invention, arranged as in the claim[s], as required to support an anticipation rejection according to *Lindemann Maschinenfabrik GmbH v. American Hoist & Derrick Co.*, 730 F.2d 1452, 221 USPQ 481, 485 (Fed. Cir. 1984). Accordingly, withdrawal of the rejections of claims 1-3, 8, 10-13, and 17-22, 50, and 51 based on Motoki is respectfully requested.

c. Novelty of Independent Claim 26 and Claims Depending Therefrom

Independent claim 26 requires:

26. **Single crystal III-V nitride material grown exclusively in a bulk growth direction along the c-axis, having a nominal diameter of at least 2 inches, and having uniformly low dislocation density not exceeding  $3 \times 10^6$  dislocations per  $\text{cm}^2$  of growth surface area.**

(Emphasis added.)

Each of the “grown exclusively in a bulk growth direction along the c-axis” and “2 inch diameter” limitations coupled with the uniformly low dislocation density not exceeding low  $3 \times 10^6$  dislocations per  $\text{cm}^2$ , provides a basis for distinguishing claim 26 over Motoki.

As to the first distinction, it has been demonstrated previously that Motoki **requires growth in two directions** to achieve low defect density within the scope of claim 2. But Motoki further includes an express disclaimer against unidirectional bulk growth along the c-axis. See, e.g., Motoki, col. 30, lines 34-35: “The GaN growth (C;c) upon the seed C1 is not included in the

4241-685

**scope of the present invention.**” In view of this express disclaimer against unidirectional c-axis growth, there can be no anticipation of the claim.

As to the second **“2 inch diameter”** limitation of claim 26, Motoki fails to teach fabrication of such a larger area (rather, Motoki teaches 2.5 to 3 cm articles, substantially smaller than the 2 inch (approximately 5 cm)) size required by the claim) – *let alone* enabling one skilled in the art to produce a 2 inch diameter article of uniformly low defect density single crystal III-V nitride material. Again, Motoki teaches at least one **“growth – cut – perpendicular growth”** cycle. Each crystal growth must be exceeding thick to achieve III-V nitride material of a desired diameter. Motoki describes growth of thick epitaxial layers between 2.5 and 3 cm in thickness. See., e.g., col. 28, line 60 – col. 29, line 16, describing growth of a 3 cm tall GaN epitaxial layer over a period of 180 hours; col. 30, lines 37-65, describing growth of a 2.5 cm tall GaN layer over a period of 180 hours; and col. 31, line 62 – col. 32, line 27, similarly describing growth of a 2.5 cm tall GaN layer over a period of about 180 hours.

As detailed in the enclosed Declaration of Robert P. Vaudo, at least one of the inventors of the present application has substantial experience with the development and commercialization of GaN substrate products, including methods for growing hybrid vapor phase epitaxial GaN and testing and quality control procedures for the same. Vaudo Decl., ¶¶ 1-3. Mr. Vaudo attests that it is exceedingly difficult to grow GaN ingots substantially greater than 10-20 mm long (e.g., thick) without generating a large number of polycrystalline inclusion defects. *Id.*, ¶ 4. Such polycrystalline defects are typically caused by transport of undesirable particulates from internal reactor components, and they would be expected to be of sufficient size and/or number to

4241-685

substantially interfere with operation of any GaN-based electronic or optoelectronic device constructed from GaN so grown. Id.

Mr. Vaudo further attests that, based on his experience and review of U.S. Patent No. 6,468,882 to Motoki, Motoki does not enable one skilled in the art to grow epitaxial, c-axis GaN having a diameter of at least 2 inches (i.e., greater than 5 cm) at a uniformly low defect density of uniformly low dislocation density not exceeding  $3 \times 10^6$  dislocations per square centimeter of growth surface area. Vaudo Decl., ¶ 7. Any attempt to grow a GaN wafer of these size and low defect density characteristics would generate a large number of polycrystalline inclusion defects aggregating to a substantial area of unusable material in the resulting product. Id.

As a result, any extension of Motoki to the size range of claim 26 is neither supported nor enabled by the reference.

Since claims 27-37 and 41-49 all depend, whether directly or indirectly, from claim 26, these claims inherently include all of the limitations of claim 26. As a result, each of these dependent claims is similarly novel over Motoki for at least the reasons stated above.

For at least these reasons, Motoki fails to disclose "each and every element of the claimed invention, arranged as in the claim[s], as required to support an anticipation rejection according to *Lindemann Maschinenfabrik GmbH v. American Hoist & Derrick Co.*, 730 F.2d 1452, 221 USPQ 481, 485 (Fed. Cir. 1984). Accordingly, withdrawal of the rejections of claims 26-37 based on Motoki is respectfully requested.



4241-685

Based on the foregoing, withdrawal of all anticipation rejections under 35 U.S.C. 102 is respectfully requested.

2. Traversal of Rejections Under 35 U.S.C. 103

In the November 9, 2005 Office Action, claims 9, 14-16 and 23-25 were rejected under 35 U.S.C. 103(a) as being obvious over U.S. 6,468,882 (Motoki), while claims 4-7 were rejected under 35 U.S.C. 103(a) as being obvious over Motoki in view of US 2002/0189532 to Motoki ("Motoki '532"). The §103 rejections based on are traversed by the present claims.

a. Rejections Under § 103 Generally

Three requirements must be met for a *prima facie* case of obviousness. First the prior art reference(s) must teach all of the limitations of the claims. M.P.E.P. § 2143.03. Second, there must be a motivation to modify the reference or combine the teachings to produce the claimed invention. M.P.E.P. § 2143.01. Third, a reasonable expectation of success is required. M.P.E.P. § 2143.02. In addition, the teaching or suggestion to combine and the expectation of success must both be found in the prior art and not based on Applicant's disclosure. M.P.E.P. § 2143.

b. Disclosure of Motoki and Motoki '532

The disclosure of Motoki has been discussed previously. Motoki '532 teaches the doping of GaN crystals with oxygen, and the suitability of GaN for producing electronic devices.

c. Traversal of Obviousness Rejections Based on Motoki

As noted previously, claims 9, 14-16 and 23-25 were rejected under 35 U.S.C. 103(a) as being obvious over Motoki. Claim 9 has been cancelled herewith. Claims 14, 15, and 23-25 all depend, whether directly or indirectly, from claim 1. The arguments as to novelty of claim 1

4241-685

apply equally here, and are incorporated by reference. Briefly, claim 1 requires an uncut single crystal III-V nitride material having a specified large area and uniform low dislocation density – something that Motoki cannot achieve without growing, cutting, and then growing again. Since Motoki fails to teach all of the elements of claim 1 (e.g., uncut III-V nitride material), as required by M.P.E.P. § 2143.03 to support a *prima facie* case of obviousness, claim 1 is not obvious over Motoki. Concomitantly, claims 14, 15 and 23-25 that depend from claim 1 are similarly not obvious over Motoki.

The distinctions between claim 16 and Motoki has been similarly discussed previously. Claim 16 requires, inter alia, large area and low defect density GaN having a diameter of greater than 2 inches. It has already been established that Motoki fails to teach GaN of such size, and that Motoki fails to enable one skilled in the art to achieve the subject matter of claim 16. Accordingly, since Motoki fails to teach all of the elements of claim 16, as required by M.P.E.P. § 2143.03 to support a *prima facie* case of obviousness, claim 16 is not obvious over Motoki.

d. Traversal of Obviousness Rejections Based on Motoki and Motoki '532

As noted previously, claims 4-7 were rejected under 35 U.S.C. 103(a) as being obvious over Motoki in view Motoki '532. All of these claims 4-7 depend from claim 1. Motoki '532 fails to plug the gaps in disclosure left by Motoki relative to claim 1. With the novelty and non-obviousness of claim 1 over Motoki having already been established, such arguments are hereby extended as to claims 4-7, which inherently include all of the limitations of claim 1. Since Motoki '532 fails to remedy the shortcomings in disclosure of Motoki relative to claims 4-7, there can be no *prima facie* case of obviousness, and the rejection of the claims under 35 U.S.C.

4241-685

103(a) cannot stand. Accordingly, withdrawal of the rejections of claims 4-7 is respectfully requested.

D. Petition for Extension of Time

The time for responding without fee for the September 27, 2005 Office Action passed on December 27, 2005. Accordingly, Applicant hereby petitions under 37 CFR §1.136(a) for an extension of time of one month to respond to the September 27, 2005 Office Action. Payment of the \$120.00 fee under 37 CFR §1.17(a) is provided by the attached Credit Card Payment form. Any deficiency in such payment is hereby authorized to be charged to USPTO Deposit Account Number 08-3284 of Intellectual Property/Technology Law.

E. No Fee Payable For Excess Claims

Applicants previously paid for original claims 1-120. No additional independent claims or total claims have been added by the present amendment. Therefore, no excess claim fees are believed to be due and payable at this time. If Applicants are incorrect in this belief, however, then please treat this as authorization to charge any deficiency in payment necessary to enter the present amendment to USPTO Deposit Account Number 08-3284 of Intellectual Property/Technology Law.

F. New Power of Attorney

A new power of attorney (form PTO/SB/80) and an accompanying Statement Under 37 CFR 3.73(b) (form PTO/SB/96) are submitted herewith.

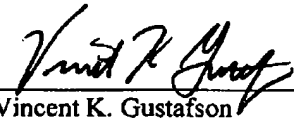
4241-685

**CONCLUSION**

Claims 1-8 and 10-51 as provided herein are fully patentably distinguished over the art and in allowable condition. Allowance of the claims therefore is requested and merited.

If any issues remain outstanding, incident to the formal allowance of the application, the examiner is requested to contact the undersigned attorney at (919) 419-9350 to discuss their resolution, in order that this application may be passed to issue at an early date.

Respectfully submitted,

  
\_\_\_\_\_  
Vincent K. Gustafson  
Reg. No. 46,182  
Attorney for Applicants

**INTELLECTUAL PROPERTY/  
TECHNOLOGY LAW**  
Phone: (919) 419-9350  
Fax: (919) 419-9354  
Attorney File No.: 4241-685

Enclosures: Declaration of Robert Vaudo Under 37 CFR § 1.132 [3 pgs]  
Power of Attorney (form PTO/SB/80) [1 pgs]  
Statement Under 37 CFR 3.73(b) (form PTO/SB/96) [5 pg]  
Credit Card Payment Form [1 pg]